ESRF	**Experiment title:** Critical x-ray scattering from an ultrathin FeCo(001) film.	**Experiment number:** SI 291
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Report:

We have done x-ray scattering experiments at the Troika beamline on an 178Å $Fe_{54}Co_{46}$(001)| MgO(00 1) thin film. The aim of the experiment was to explore the character of the continous order-disorder phase transition in reduced dimensions. A foregoing experiment with an 1 μm thick sample [l] revealed that near the surface in a region of about 40 Å order remains above bulk T_c which is about 720 °C for a bulk sample. The preliminary experimental result with the thin film sample is that the phase transition does not take place up to 795°C. We see no onset of decreasing order in the whole temperature range.

The sample was epitaxially grown in our laboratory by MBE and always stayed at a pressure better than 1 0^{-8} torr in a transportable UHV-chamber. The sample was mounted on a molybdenum holder, which was radiation-heated by a Ta-wire and could be heated up to 800°C. Temperature was measured with a thermocouple at the holder and an optical pyrometer focused at the sample surface. We used a wavelenth of λ = 0.75 1 Å and a diamond (111) monochromator in combination with a SiC mirror to avoid λ/2 contamination of the primary beam. An absorbtion measurements showed no h/2 contributions.

Figure 1 shows the specular reflectivity measured at the end of the experiment, the inset shows the Laue-oscillations of the fundamental (002)-reflection ('L-scan'). The large number of oscillations shows the smoth interface of the sample. A fit to the data delivered that the sample is coherent over the whole thickness.

At the TROIKA-beamline, due to the high brilliance, we were also able to record for the first time the one electron superstructure reflection. Figure 2 shows the integrated intensity of the L-scans at the (001)-superstructure-reflection which is proportional to the square of the order parameter (Φ^2). The inset shows a L-scan at T=794.8 °C with a fit to a gaussian lineshape to get the integrated intensity. The width in L-direction does not change over the whole temperature region (not shown). Highly unexpected, no intensity-drop was observed while reaching bulk-T,(720°C). Even at 795°C the integrated intensity is unchanged. The solid line sketches the expected behavior of a bulk like sample.

To check the temperature determination we measured the thermal expansion of the substrate by the position-shift of the MgO (022)-Bragg reflection. We find indeed that the real sample temperature is somewhat lower than the nominal value, but even 50 °C above bulk-T, at highest temperatures taking the lower end of the error bar. The temperature shown in the plots and cited are the corrected temperatures, Higher temperatures could not be reached with current heating setup, so the question whether T_c of the thin film is just shifted upwards or fully supressed has to be explored with a more powerful heating system which makes it possible to heat the sample even up to the bulk martensitic phase transition temperature of 985°C which breakes up the sample into small fcc-domaines.

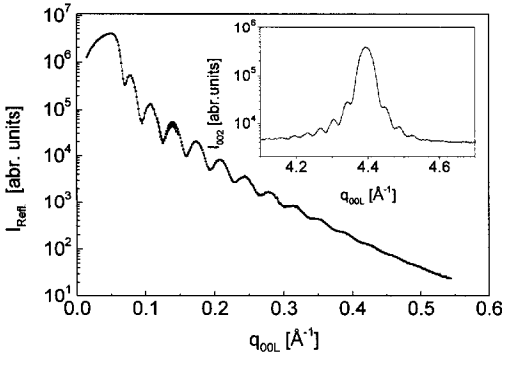

Figure1: Specular reflectivity,
inset: Laue-oscillations, see text

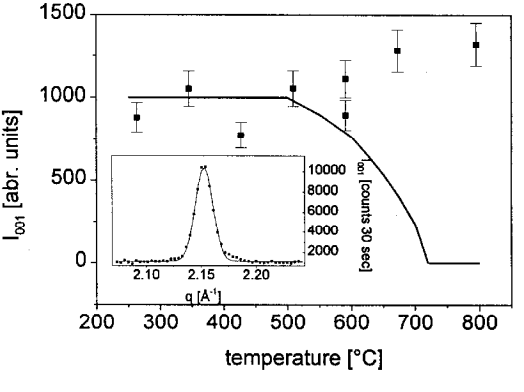

Figure 2: see text

[1]S.Krimmel, W.Donner, B.Nickel, H.Dosch, C.Sutter,G.Grübel:PRL .78, Nr. 20, p. 3880 (1997)